

GEARTECH	QUALITY PROCEDURE	No. QP8308	SHEET 1 OF 3	
		Rev. A		
Inspection for Carbon Gradient		BY RLE	DATE	11/18/99
		CKD JRM	DATE	11/18/99
<div>1. Scope</div> <div>1.1 This procedure covers preparation and analysis of carbon gradient test specimens for use in monitoring heat treatment of carburized gears.</div> <div>2. Referenced Documents</div> <div>2.1 ASTM E 350 Test Method for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron.</div> <div>3. Terminology</div> <div>3.1 Carbon gradient test specimen – A specimen heat treated with production gears and used to determine distribution of carbon versus depth below the surface.</div> <div>4. Carbon Gradient Test Specimen</div> <div>4.1 Raw material- The specimen shall be made from the same heat of steel as the production gears.</div> <div>4.2 Geometry- Geometry shall be in accordance with Figure 1.</div> <div>4.3 Traceability- Specimen shall be stamped with an identification number that is traceable to the gear it represents and the heat of steel.</div> <div>4.4 Heat treatment- The specimen shall be wired to a gear and accompany the gear through all heat treatment including, but not limited to, normalizing, carburizing, and quenching</div> <div>4.4.1 Furnace load- The furnace load containing the test specimen shall approximate actual production conditions in terms of load density, configuration, and surface area to be carburized.</div> <div>4.5 Tempering- After carburizing and hardening, temper the specimen in lead, bismuth, argon, or vacuum for 1 ½ hours at 600 - 650 °C.</div> <div>4.6 Cleaning and straightening- After tempering, grit blast lightly. Clean centers and straighten specimen to 0.03 mm TIR. Wash specimen with soap and water. Rinse with methanol and dry.</div> <div>5. Machining specimen</div> <div>5.1 End of specimen- Machine approximately 5 mm off the small end of the specimen to a diameter of approximately 15 mm to ensure that the case on the end does not contaminate chips for carbon analysis.</div> <div>5.2 Record diameter- Before each machining, record diameter of specimen with a micrometer. Maximum allowable taper shall be 0.03 mm on the radius.</div> <div>5.3 Machine diameter- Specimen shall be machined dry with sharp high-speed cutting tools taking necessary precautions to avoid burning. Machine a maximum of 0.05 mm from the radius to clean the surface. Save chips for analysis. Next, machine increments of 0.13 mm from the radius to a depth of twice the maximum expected case depth. Save chips from each increment in separate, properly marked envelopes. Take precautions to ensure chips from each cut are not burnt or contaminated by dirt, paper, oil, or chips from preceding cuts.</div>				

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6. Analysis of carbon

6.1 Combustion chemical analysis- Carbon content shall be determined by combustion chemical analysis in accordance with ASTM E 350 of all chips from each cut.

7. Interpretation of results

7.1 Carbon gradient- Results of the combustion chemical analysis shall be plotted on a graph of carbon versus depth from the surface.

7.2 Surface carbon- Surface carbon shall be determined from the intersection between the carbon gradient curve and the ordinate of the graph of carbon versus depth from the surface.

8. Acceptance Criteria

8.1 Surface carbon- The surface carbon shall be within the range specified in Table 1 corresponding to the total alloy content of the production gears.

Table 1 Surface Carbon	
Total alloy content (%)	Surface carbon in case (%)
≤ 2.5	0.80 – 1.00
2.5 – 3.5	0.75 – 0.95
> 3.5	0.70 – 0.90

9. Report

9.1 The report shall include the following:

9.1.1 Identification number of carbon gradient test specimen,

9.1.2 Graph of carbon gradient,

9.1.3 Surface carbon.

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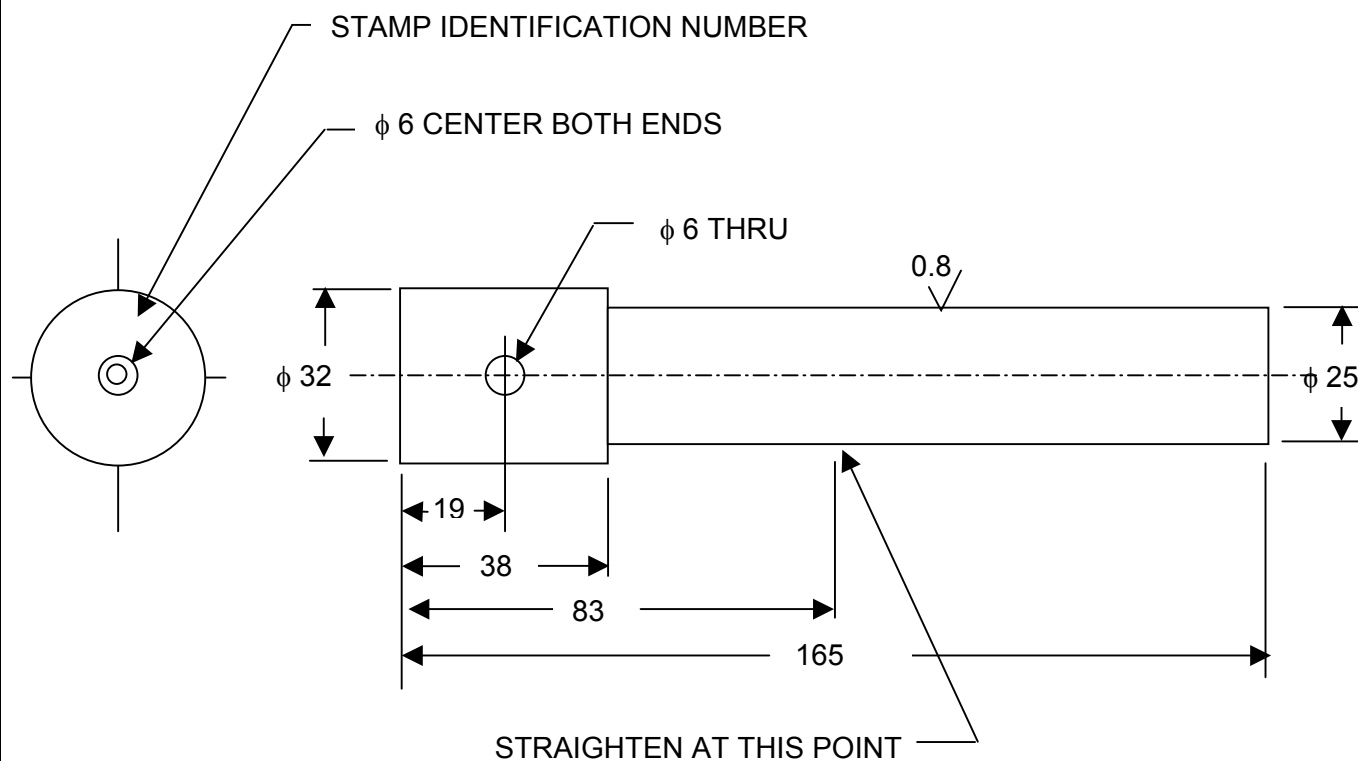


FIGURE 1